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To be continued to the last page

(54) [Title of the Invention]

DEFECT CORRECTING METHOD OF ACTIVE MATRIX SUBSTRATE AND MANUFACTURING METHOD OF LIQUID CRYSTAL PANEL

(57) [Abstract]

[Problem] To correct, under a state of an active matrix substrate, a short-circuit defect between an upper electrode and a lower electrode owing to a pinhole defect in an auxiliary capacity part.

[Means for Resolution] In the auxiliary capacity part

constituted by a common signal wiring 3 or a scanning wiring (lower electrode), an insulation film 7 and a picture element electrode 5 (upper electrode), in a case where a short-circuit between the lower electrode and the upper electrode is generated owing to a pinhole 12 of the insulation film 7, an upper electrode portion 13 around the short-circuit defect part 12 is removed by irradiating a light energy. Since a defect correction is performed under the state of the active matrix substrate before being bonded together with an opposed substrate, effects of a refraction index and a transmittance of a glass substrate and a color filter forming part and effects on a liquid crystal orientation and so forth don't exist, so that no defective flows to a post-process. If a short wavelength laser that is an ultraviolet ray whose oscillation wavelength is 360 nm or less, for example, a 4th higher harmonic of YAG laser, is used, only the upper electrode around the short-circuit defect part can be precisely removed without exerting an effect on a lower layer film.

[Claims]

[Claim 1] A defect correcting method of an active matrix substrate, in which --in the active matrix substrate in which plural scanning wirings and plural signal wirings are provided so as to mutually intersect, a picture element electrode connected to both the wirings through a switching element provided near an intersection part of both the wirings is provided, additionally plural common signal wirings are provided in a lower layer of the picture element electrode through an insulation film so as to be partially superimposed with the picture element electrode, and thereby there is constituted an auxiliary capacity part in which a common signal wiring portion in a superimposed part is made a lower electrode and a picture element electrode portion in the superimposed part is made an upper electrode-- in a case where a short-circuit defect between the upper electrode and the lower electrode is generated, the defect is corrected,

wherein an optional light energy is irradiated to a short-circuit defect part, thereby removing the upper electrode around the short-circuit defect part.

[Claim 2] A defect correcting method of an active matrix substrate, in which --in the active matrix substrate in which plural scanning wirings and plural signal wirings are provided so as to mutually intersect, a picture element electrode connected to both the wirings through a switching element

provided near an intersection part of both the wirings is provided, additionally the scanning wiring adjoining the scanning wiring connected to the picture element electrode and the picture element electrode are partially superimposed through an insulation film, and thereby there is constituted an auxiliary capacity part in which a scanning wiring portion in a superimposed part is made a lower electrode and a picture element electrode portion in the superimposed part is made an upper electrode-- in a case where a short-circuit defect between the upper electrode and the lower electrode is generated, the defect is corrected,

wherein an optional light energy is irradiated to a short-circuit defect part, thereby removing the upper electrode around the short-circuit defect part.

[Claim 3] A defect correcting method of an active matrix substrate set forth in claim 1 or claim 2, wherein a laser light is irradiated as the light energy.

[Claim 4] A defect correcting method of an active matrix substrate set forth in claim 3, wherein a laser that is an ultraviolet ray whose oscillation wavelength is 360 nm or less is used in order to irradiate the light energy.

[Claim 5] A defect correcting method of an active matrix substrate set forth in claim 4, wherein a 4th higher harmonic of YAG laser is irradiated as the light energy.

[Claim 6] A manufacturing method of a liquid crystal panel

containing a process in which, after a defect has been corrected by a defect correcting method of an active matrix substrate set forth in any of claim 1 to claim 5, the active matrix substrate and an opposed substrate are bonded together and a liquid crystal is injected between both the substrates.

[Detailed Description of the Invention]

[0001]

[Technical Field to which the Invention Belongs] The present invention relates to a method of correcting a defect in a case where a short-circuit defect is generated in an auxiliary capacity part in an active matrix substrate used in an AV (Audio Visual) equipment such as television set, an OA (Office Automation) equipment such as word processor, and an information terminal display equipment such as notebook type personal computer, and to a method of manufacturing a liquid crystal panel.

[0002]

[Prior Art] A liquid crystal display unit in which an electro-optical effect of the liquid crystal is utilized at present in the display unit is utilized in various fields such as the OA equipment and the AV equipment, besides the information terminal display equipment such as the notebook type personal computer.

[0003] This liquid crystal display unit has an active matrix substrate possessing mutually intersecting gate signal wire

(scanning wiring) and source signal wire (signal wiring), many picture element electrodes formed in a matrix-like form, a switching element for controlling the picture element electrodes, and the like. And, it has a constitution in which this active matrix substrate and an opposed substrate possessing a color filter, opposed electrodes and the like are bonded together such that mutual electrode forming faces are faced while keeping a predetermined interstice, and a liquid crystal layer is interposed in the interstice between both the substrates.

[0004] A manufacturing process of this active matrix substrate is complex, and it is obliged to pass through many manufacturing processes. For this reason, defects such as an inclusion of foreign matter and a short-circuit between the picture element electrodes and the scanning wiring or the signal wiring are liable to occur, and it is very difficult to make them completely zero. Accordingly, in order to improve a production yield, it becomes a very important problem to early detect these defects and perform a correction as occasion demands.

[0005] Hitherto, there has been proposed a method in which, after a liquid crystal panel has been produced by bonding together the above active matrix substrate and the opposed substrate and injecting the liquid crystal between both the substrates, it is detected whether or not a line defect and

a point defect exist by performing a lighting test, and that defect portion is corrected by using a redundant structure or the like, if it is correctable one.

[0006] However, in the case where the defect is detected after the active matrix substrate and the opposed substrate have been bonded together and the liquid crystal has been injected between both the substrates to thereby produce the liquid crystal panel, the liquid crystal panel which has a serious defect and in which that defect cannot be corrected has to be discarded. Accordingly, there has been a problem that the production yield is reduced in a post-process and thus a manufacturing cost becomes high.

[0007] Whereupon, in recent years, it has become desirable that the serious defect is detected under a state of the active matrix substrate before being bonded together with the opposed substrate and, further, a correctable defect such as short-circuit defect is corrected in a pre-process. And, it has become possible to detect, under the substrate state, the defect by a method such as image processing and resistance test, and with this it has been being performed to make such a process system that the defect is corrected under the substrate state, thereby flowing no defective to the post-process.

[0008]

[Problems that the Invention is to Solve] By the way, in the above liquid crystal display unit, there is known a

constitution in which, in order to improve a display quality, the picture element electrode and the common single wiring or the adjoining scanning wiring are partially superimposed through an insulation film, and a superimposed part is made the auxiliary capacity part.

[0009] In the above constitution, in a case where the short-circuit defect occurred between an upper electrode (the picture element electrode) and a lower electrode (the common signal wiring or the scanning wiring) of the auxiliary capacity, since an electric potential of the same phase as an opposed electrode is applied to the picture element electrode short-circuited with the common signal wiring, it always becomes a bright spot in a normally white mode which becomes a main stream at present, so that the display quality is reduced. On the other hand, since a constant electric potential which is minus with respect to the opposed electrode is being almost always applied to the picture element electrode short-circuited with the scanning wiring, it almost always becomes a black spot in the normally white mode which becomes the main stream at present, so that the display quality is reduced.

[0010] In the case where such a defect occurred, if it is attempted to correct it after a production of the liquid crystal panel like the prior art, a utilizable laser is limited owing to effects of a refraction index and a transmittance of a glass substrate and a color filter forming part and effects on a

liquid crystal orientation and the like, so that it could not be corrected to a normal picture element.

[0011] The invention is one made in order to solve such problems of the prior art, and its object is to provide a defect correcting method of an active matrix substrate and a manufacturing method of a liquid crystal panel, in each of which a short-circuit defect between an upper electrode and a lower electrode in an auxiliary capacity part can be corrected under a state of the active matrix substrate before being bonded together with an opposed substrate.

[0012] [Means for Solving the Problems] A defect correcting method of an active matrix substrate of the invention is a method in which --in the active matrix substrate in which plural scanning wirings and plural signal wirings are provided so as to mutually intersect, a picture element electrode connected to both the wirings through a switching element provided near an intersection part of both the wirings is provided, additionally plural common signal wirings are provided in a lower layer of the picture element electrode through an insulation film so as to be partially superimposed with the picture element electrode, and thereby there is constituted an auxiliary capacity part in which a common signal wiring portion in a superimposed part is made a lower electrode and a picture element electrode portion in the superimposed part is made an upper electrode-- in a case where a

short-circuit defect between the upper electrode and the lower electrode is generated, the defect is corrected, wherein an optional light energy is irradiated to a short-circuit defect part, thereby removing the upper electrode around the short-circuit defect part; and by this fact the above object is achieved.

[0013] A defect correcting method of an active matrix substrate of the invention is a method in which --in the active matrix substrate in which plural scanning wirings and plural signal wirings are provided so as to mutually intersect, a picture element electrode connected to both the wirings through a switching element provided near an intersection part of both the wirings is provided, additionally the scanning wiring adjoining the scanning wiring connected to the picture element electrode and the picture element electrode are partially superimposed through an insulation film, and thereby there is constituted an auxiliary capacity part in which a scanning wiring portion in a superimposed part is made a lower electrode and a picture element electrode portion in the superimposed part is made an upper electrode-- in a case where a short-circuit defect between the upper electrode and the lower electrode is generated, the defect is corrected, wherein an optional light energy is irradiated to a short-circuit defect part, thereby removing the upper electrode around the short-circuit defect part; and by this fact the above object

is achieved.

[0014] It is preferable that a laser light is irradiated as the light energy.

[0015] It is preferable that a laser that is an ultraviolet ray whose oscillation wavelength is 360 nm or less is used in order to irradiate the light energy.

[0016] It is preferable that a 4th higher harmonic of YAG laser is irradiated as the light energy.

[0017] A manufacturing method of a liquid crystal panel of the invention contains a process in which, after a defect has been corrected by a defect correcting method of an active matrix substrate of the invention, the active matrix substrate and an opposed substrate are bonded together and a liquid crystal is injected between both the substrates; and by this fact the above object is achieved.

[0018] Hereunder, it is explained about actions of the invention.

[0019] In the invention, in the auxiliary capacity part constituted by the common signal wiring or the scanning wiring (lower electrode), the insulation film and the picture element electrode (upper electrode), in the case where the short-circuit between the lower electrode and the upper electrode is generated, the light energy is irradiated, thereby removing the upper electrode around the short-circuit defect part. By this, the short-circuit defect part and the picture element

electrode are isolated, so that the short-circuit between the lower electrode and the upper electrode is solved. Since a defect correction is performed under the state of the active matrix substrate before being bonded together with an opposed substrate, there are no effects of the refraction index and the transmittance of the glass substrate and the color filter forming part and no effects on the liquid crystal orientation and so forth like the case where the defect correction is performed under the liquid crystal state, so that a reliability of the correction is improved. Since no defective flows to a post-process and there is also no necessity to previously provide a redundant structure for the defect correction, a production yield is improved.

[0020] If the laser light is used as the light energy, since the working is possible by a non-contact, the correction can be performed rapidly and easily.

[0021] If a short wavelength laser that is an ultraviolet ray whose oscillation wavelength is 360 nm or less, for example, a 4th higher harmonic of YAG laser, is used, only the upper electrode around the short-circuit defect part can be precisely removed without exerting an effect on a lower layer film.

[0022]

[Mode for Carrying Out the Invention] Hereunder, it is explained about embodiments of the invention while referring to the drawings.

[0023] (Embodiment 1) In this embodiment, it is explained about an active matrix liquid crystal panel of a Cs on Common structure.

[0024] Fig.1 is a plan view of a liquid crystal panel of the embodiment 1, and Fig.2 is a sectional view of I-I' line portion of the same.

[0025] In this liquid crystal panel, as to an active matrix substrate, a scanning wiring 2 and a signal wiring 4 are provided on a glass substrate 11 while being mutually intersected and, in the vicinity of an intersection part of both the wirings, a TFT (Thin Film Transistor) is provided as a switching element 6. In a rectangle-like region partitioned by both the wirings, a picture element electrode 5 is disposed in a matrix-like form, and connected to both the wirings through the switching element 6.

[0026] Additionally, between the adjoining scanning wirings 2, a common signal wiring 3 is provided in a direction parallel to the scanning wiring 2 and, thereon, the picture element electrode 5 is partially superimposed through an insulation film 7. An auxiliary capacity part 1 is constituted from the common signal wiring 3, the insulation film 7 and the picture element electrode 5 in the superimposed part. The common signal wiring 3 comprises a metal thin film, for example Ta and Al etc., of about 300 nm - 500 nm in thickness, the picture element electrode 5 comprises a transparent conductive film,

for example ITO (Indium Tin Oxide) etc., of about 100 nm - 200 nm in thickness, and the insulation film 7 comprises an insulation film (gate insulation film), for example SiN_x and SiO_x etc., of about 300 nm - 500 nm in thickness.

[0027] This active matrix substrate is bonded together with an opposed substrate in which an opposed electrode 9 is provided on a glass substrate 10, and a liquid crystal layer 8 is interposed between both the substrates.

[0028] In this liquid crystal panel, as shown in Fig.2, in a case where a pinhole 12 is generated in the insulation film 7 and thus the common signal wiring 3 and the picture element electrode 5 in the auxiliary capacity part are short-circuited, since an electric potential of the same phase is applied to the opposed electrode 9 and the common signal wiring 3, no electric potential is applied between the picture element electrode 5 short-circuited with the common signal wiring 3 and the opposed electrode 9. Therefore, it is always displayed as the bright spot in a normally white mode liquid crystal which becomes the main stream at present, so that it becomes a very conspicuous defect reducing the display quality.

[0029] If such a short-circuit defect in the auxiliary capacity part 1 is corrected under a liquid crystal panel state like the prior art, the correction is difficult owing to effects of the refraction index and the transmittance of the glass substrate and the color filter forming part and effects on the

liquid crystal orientation and the like. Further, there is also a fear that debris and foreign matters scattered by the correction remain in the liquid crystal layer, thereby generating a display badness.

[0030] Whereupon, as shown in Fig.3, in this embodiment, under an active matrix substrate state before being bonded together with the opposed substrate, a light energy is irradiated to the short-circuit defect part 12, thereby performing a defect correction. A detection of the defect can be detected by the method such as image processing and resistance test.

[0031] Here, if a fundamental wave of YAG laser or the like is irradiated, since there is a fear that a lower layer film is effected and thus the common signal wiring 3 is cut, a short wavelength laser such as a 4th higher harmonic (266 nm) of YAG laser is used in this embodiment.

[0032] By this, as shown in Fig.4, the pinhole 12 is isolated from the picture element electrode 5 by removing a picture element electrode portion 13 around the short-circuit defect part, and thereby it is possible to solve the short-circuit between the upper electrode and the lower electrode in the auxiliary capacity part.

[0033] Incidentally, since a reduction of the auxiliary capacity part 1 exerts an influence on a display state of the picture element, it is necessary that an area to be removed by irradiating the light energy is adjusted to, for example,

within 2 μm□ - 5 μm □ or the like by considering a design margin (for example, within ±5%).

[0034] In a portion where the picture element electrode 5 has been removed, since no electric potential is applied between it and the opposed electrode, a light leak is generated, but no problem occurs because the common signal wiring 3 is formed by a metal thin film having a shading ability such as, for example, Al, Ti and Ta.

[0035] By bonding the active matrix substrate defect-corrected in this manner and the opposed substrate together and injecting the liquid crystal into the interstice between both the substrates, the liquid crystal panel of this embodiment is obtained.

[0036] (Embodiment 2) In this embodiment, it is explained about an active matrix liquid crystal panel of the Cs on Gate structure.

[0037] Fig.5 is a plan view of a liquid crystal panel of the embodiment 2, and Fig.6 is a sectional view of II-II' line portion of the same.

[0038] In this liquid crystal panel, as to the active matrix substrate, the scanning wiring 2 and the signal wiring 4 are provided on the glass substrate 11 while being mutually intersected and, in the vicinity of the intersection part of both the wirings, the TFT (Thin Film Transistor) is provided as the switching element 6. In the rectangle-like region

partitioned by both the wirings, the picture element electrode 5 is disposed in the matrix-like form, and connected to both the wirings through the switching element 6.

[0039] Additionally, the picture element electrode 5 is extended onto the scanning wiring 2 adjoining the scanning wiring 2 connected to the picture element electrode 5, and partially superimposed with the scanning wiring through the insulation film 7. The auxiliary capacity part 1 is constituted from the scanning wiring 2, the insulation film 7 and the picture element electrode 5 in the superimposed part. The scanning wiring 2 comprises the metal thin film, for example Ta and Al etc., of about 300 nm - 500 nm in thickness, the picture element electrode 5 comprises the transparent conductive film, for example ITO etc., of about 100 nm - 200 nm in thickness, and the insulation film 7 comprises the insulation film (gate insulation film), for example SiN_x and SiO_x etc., of about 300 nm - 500 nm in thickness.

[0040] This active matrix substrate is bonded together with the opposed substrate in which the opposed electrode 9 is provided on the glass substrate 10, and the liquid crystal layer 8 is interposed between both the substrates.

[0041] In this liquid crystal panel, as shown in Fig.6, in the case where the pinhole 12 is generated in the insulation film 7 and thus the scanning wiring 2 and the picture element electrode 5 in the auxiliary capacity part are short-circuited,

since a constant electric potential which is minus with respect to the opposed electrode 9 is almost always applied to the scanning wiring 2, an electric potential is almost always applied between the picture element electrode 5 short-circuited with the common signal wiring 3 and the opposed electrode 9. Therefore, it is almost always displayed as the black spot in the normally white mode liquid crystal which becomes the main stream at present, so that it becomes a defect reducing the display quality.

[0042] If such a short-circuit defect in the auxiliary capacity part 1 is corrected under the liquid crystal panel state like the prior art, the correction is difficult owing to effects of the refraction index and the transmittance of the glass substrate and the color filter forming part and effects on the liquid crystal orientation and the like. Further, there is also the fear that debris and foreign matters scattered by the correction remain in the liquid crystal layer, thereby generating the display badness.

[0043] Whereupon, as shown in Fig.7, in this embodiment, under the active matrix substrate state before being bonded together with the opposed substrate, the light energy is irradiated to the short-circuit defect part 12, thereby performing the defect correction. The detection of the defect can be detected by the method such as image processing and resistance test.

[0044] Here, if the fundamental wave of YAG laser or the like

is irradiated, since there is a fear that the lower layer film is effected and thus the scanning wiring 2 is cut, the short wavelength laser such as a 4th higher harmonic (266 nm) of YAG laser is used in this embodiment.

[0045] By this, as shown in Fig.8, the pinhole 12 is isolated from the picture element electrode 5 by removing the picture element electrode portion 13 around the short-circuit defect part, and thereby it is possible to solve the short-circuit between the upper electrode and the lower electrode in the auxiliary capacity part.

[0046] Incidentally, since the reduction of the auxiliary capacity part 1 exerts the influence on the display state of the picture element, it is necessary that the area to be removed by irradiating the light energy is adjusted to, for example, within 2 μm - 5 μm or the like by considering the design margin (for example, within ±5%).

[0047] In the portion where the picture element electrode 5 has been removed, since no electric potential is applied between it and the opposed electrode, the light leak is generated, but no problem occurs because the scanning wiring 2 is formed by the metal thin film having the shading ability such as, for example, Al, Ti and Ta.

[0048] By bonding the active matrix substrate defect-corrected in this manner and the opposed substrate together and injecting the liquid crystal into the interstice between both the

substrates, the liquid crystal panel of this embodiment is obtained.

[0049] Incidentally, in the embodiment 1 and the embodiment 2, when isolating the short-circuit defect part and the picture element electrode by removing the upper electrode around the short-circuit defect part, it is also possible to leave the short-circuit part and remove only a portion around the short-circuit part if (1) the reduction of the auxiliary capacity part 1 is a degree exerting no effect on the display quality, and (2) no light leak occurs.

[0050] In the embodiment 1 and the embodiment 2, the 4th higher harmonic of YAG laser was used as the light energy, but other laser may be used if conditions can be set such that no effect is exerted on the lower film.

[0051] Additionally, a method utilizing the light energy other than the laser light, such as radiant ray and plasma, is also possible.

[0052]

[Advantages of the Invention] As detailedly mentioned above, in the case according to the invention, under the state of the active matrix substrate before being bonded together with the opposed substrate and before the liquid crystal is injected, the correction to the normal picture element can be performed by solving the short-circuit defect between the upper electrode and the lower electrode in the auxiliary capacity part, which

has hitherto been difficult to be corrected. Therefore, a manufacturing cost can be suppressed to a minimum limit by performing such that no correction badness flows to the post-process, and a sharp cost down can be intended by increasing the production yield. Additionally, since the defect correction is performed under the state of the active matrix substrate, a cleaning after the correction is possible, and a reliability of the correction can be improved because no foreign matters remain in the liquid crystal layer.

[Brief Description of the Drawings]

[Fig.1] It is a plan view showing a schematic constitution of a picture element part in a liquid crystal panel of an embodiment 1.

[Fig.2] It is a sectional view for explaining a short-circuit defect of an auxiliary capacity part in the liquid crystal panel of the embodiment 1.

[Fig.3] It is a sectional view for explaining a defect correcting method of an active matrix substrate of the embodiment 1.

[Fig.4] It is a sectional view for explaining the defect correcting method of the active matrix substrate of the embodiment 1.

[Fig.5] It is a plan view showing a schematic constitution of a picture element part in a liquid crystal panel of an embodiment 2.

[Fig.6] It is a sectional view for explaining a short-circuit defect of an auxiliary capacity part in the liquid crystal panel of the embodiment 2.

[Fig.7] It is a sectional view for explaining a defect correcting method of an active matrix substrate of the embodiment 2.

[Fig.8] It is a sectional view for explaining the defect correcting method of the active matrix substrate of the embodiment 2.

[Description of Reference Numerals]

1 auxiliary capacity part

2 scanning wiring

3 common signal wiring

4 signal wiring

5 picture element electrode

6 switching element

7 insulation film (gate insulation film)

8 liquid crystal layer

9 opposed electrode

10, 11 glass substrate

12 short-circuit defect part (pinhole)

13 picture element electrode portion removed by laser irradiation

Continuation of the front page

F term (reference)

FIG 4

FIG.8

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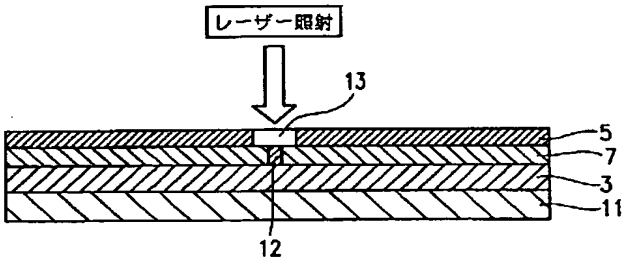
最終頁に続く

(54)【発明の名称】　アクティブマトリクス基板の欠陥修正方法および液晶パネルの製造方法

(57)【要約】
【課題】　補助容量部のピンホール欠陥による上部電極と下部電極との短絡欠陥をアクティブマトリクス基板の状態で修正する。
【解決手段】　共通信号配線３または走査配線（下部電極）と絶縁膜７と絵素電極５（上部電極）とで構成される補助容量部において、絶縁膜７のピンホール１２により下部電極と上部電極との短絡が生じている場合に、光エネルギーを照射して短絡欠陥部１２周辺の上部電極部分１３を除去する。対向基板との貼り合わせ前のアクティブマトリクス基板の状態で欠陥修正を行うので、ガラス基板やカラーフィルタ形成部の屈折率や透過率の影響、液晶配向への影響等がなく、後工程に不良品が流れない。発振波長が３６０ｎｍ以下の紫外線である短波長レーザー、例えばＹＡＧレーザーの第４高調波を用いれば、下層膜に影響を与えずに短絡欠陥周辺部の上部電極のみを精度良く除去することができる。



【特許請求の範囲】
【請求項１】　複数の走査配線および複数の信号配線が互いに交差するように設けられていると共に、両配線の交差部近傍に設けられたスイッチング素子を介して両配線と接続された絵素電極が設けられ、さらに、該絵素電極の下層に絶縁膜を介して該絵素電極と一部重畳するように複数の共通信号配線が設けられて、重畳部の共通信号配線部分を下部電極とし、該重畳部の絵素電極部分を上部電極とする補助容量部が構成されているアクティブマトリクス基板において、該上部電極と該下部電極との短絡欠陥が生じている場合に欠陥を修正する方法であって、
短絡欠陥部に任意の光エネルギーを照射して該短絡欠陥部周辺の上部電極を除去するアクティブマトリクス基板の欠陥修正方法。
【請求項２】　複数の走査配線および複数の信号配線が互いに交差するように設けられていると共に、両配線の交差部近傍に設けられたスイッチング素子を介して両配線と接続された絵素電極が設けられ、さらに、該絵素電極に接続された走査配線に隣接する走査配線と該絵素電極とが絶縁膜を介して一部重畳されて、重畳部の走査配線部分を下部電極とし、該重畳部の絵素電極部分を上部電極とする補助容量部が構成されているアクティブマトリクス基板において、該上部電極と該下部電極との短絡欠陥が生じている場合に欠陥を修正する方法であって、短絡欠陥部に任意の光エネルギーを照射して該短絡欠陥部周辺の上部電極を除去するアクティブマトリクス基板の欠陥修正方法。
【請求項３】　前記光エネルギーとしてレーザー光を照射する請求項１または請求項２に記載のアクティブマトリクス基板の欠陥修正方法。
【請求項４】　前記光エネルギーを照射するために発振波長が３６０ｎｍ以下の紫外線であるレーザーを用いる請求項３に記載のアクティブマトリクス基板の欠陥修正方法。
【請求項５】　前記光エネルギーとしてＹＡＧレーザーの第４高調波を照射する請求項４に記載のアクティブマトリクス基板の欠陥修正方法。
【請求項６】　請求項１乃至請求項５のいずれかに記載のアクティブマトリクス基板の欠陥修正方法により欠陥を修正した後で、アクティブマトリクス基板と対向基板とを貼り合わせて両基板の間に液晶を注入する工程を含む液晶パネルの製造方法。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、テレビジョンセット等のＡＶ（Ａｕｄｉｏ　Ｖｉｓｕａｌ）機器やワードプロセッサ等のＯＡ（Ｏｆｆｉｃｅ　Ａｕｔｏｍａｔｉｏｎ）機器、ノートブック型パーソナルコンピュータ等の情報端末表示機器に用いられるアクティブマトリクス基板において、補助容量部に短絡欠陥が生じている場合の欠陥修正方法および液晶パネルの製造方法に関する。
【０００２】
【従来の技術】液晶の電気光学効果を表示装置に利用した液晶表示装置は、現在、ノートブック型パーソナルコンピュータ等の情報端末表示機器をはじめとして、ＯＡ機器やＡＶ機器等、様々な分野に利用されている。
【０００３】この液晶表示装置は、互いに交差するゲート信号線（走査配線）およびソース信号線（信号配線）、マトリクス状に形成された多数の絵素電極、および絵素電極を制御するためにスイッチング素子等を備えたアクティブマトリクス基板を有している。そして、このアクティブマトリクス基板とカラーフィルタや対向電極等を備えた対向基板とが、所定の隙間を保って互いの電極形成面が向かい合うように貼り合わせられ、両基板の隙間に液晶層が挟持された構成を有している。
【０００４】このアクティブマトリクス基板の製造工程は複雑であり、多くの製造プロセスを経ることが余儀なくされる。このため、異物の混入や絵素電極と走査配線や信号配線との短絡等の欠陥が生じ易く、これを完全に無くすことは非常に困難である。従って、これらの欠陥を早期に検出し、必要に応じて修正を行うことは、生産歩留りを向上させるために非常に重要な課題となっている。
【０００５】従来では、上記アクティブマトリクス基板と対向基板とを貼り合わせ、涼気板の間に液晶を注入して液晶パネルを作製した後で点灯検査を行って線欠陥や点欠陥の有無を検出し、冗長構造等を用いてその欠陥部分が修正可能なものであれば修正するという方法が提案されてきた。
【０００６】しかしながら、アクティブマトリクス基板と対向基板とを貼り合わせて両基板の間に液晶を注入し、液晶パネルを作製した後で欠陥を検出する場合、重度な欠陥を有し、その欠陥が修正不可能な液晶パネルは廃棄せざるを得ない。従って、後工程において生産歩留りが低下して製造コストが高くなるという問題があった。
【０００７】そこで、近年では、対向基板と貼り合わせる前のアクティブマトリクス基板の状態で重度な欠陥を検出し、また、短絡欠陥等の修正可能なものは前工程で修正することが望まれるようになってきた。そして、これらの欠陥は基板状態で、画像処理や抵抗検査等の手法によって検出できるようになり、それに伴って基板状態で欠陥を修正して後工程に不良品を流さないような工程システム作りがなされてきている。
【０００８】
【発明が解決しようとする課題】ところで、上述の液晶表示装置においては、表示品位を向上させるために、絵素電極と共通信号配線や隣接する走査配線を絶縁膜を介して一部重畳させ、重畳部を補助容量部とした構成が知

られている。

【０００９】上記構成において、補助容量の上部電極（絵素電極）と下部電極（共通信号配線や走査配線）に短絡欠陥が生じた場合、共通信号配線と短絡した絵素電極には対向電極と同じ位相の電位が印加されるので、現在主流となっているノーマリホワイトモードでは常に輝点となり、表示品位が低下する。一方、走査配線と短絡した絵素電極には対向電極に対してマイナスの一定電位がほぼ常に印加されているので、現在主流となっているノーマリホワイトモードではほぼ常に黒点となり、表示品位が低下する。

【００１０】このような欠陥が生じた場合、従来のように液晶パネルの作製後に修正しようとすると、ガラス基板やカラーフィルタ形成部の屈折率や透過率の影響、液晶配向への影響等のために利用できるレーザーが限定され、正常絵素に修正することができなかった。

【００１１】本発明はこのような従来技術の課題を解決すべくなされたものであり、対向基板との貼り合わせ前のアクティブマトリクス基板の状態で補助容量部の上部電極と下部電極との短絡欠陥を修正することが可能なアクティブマトリクス基板の欠陥修正方法および液晶パネルの製造方法を提供することを目的とする。

【００１２】

【課題を解決するための手段】本発明のアクティブマトリクス基板の欠陥修正方法は、複数の走査配線および複数の信号配線が互いに交差するように設けられていると共に、両配線の交差部近傍に設けられたスイッチング素子を介して両配線と接続された絵素電極が設けられ、さらに、該絵素電極の下層に絶縁膜を介して該絵素電極と一部重畳するように複数の共通信号配線が設けられて、重畳部の共通信号配線部分を下部電極とし、該重畳部の絵素電極部分を上部電極とする補助容量部が構成されているアクティブマトリクス基板において、該上部電極と該下部電極との短絡欠陥が生じている場合に欠陥を修正する方法であって、短絡欠陥部に任意の光エネルギーを照射して該短絡欠陥部周辺の上部電極を除去し、そのことにより上記目的が達成される。

【００１３】本発明のアクティブマトリクス基板の欠陥修正方法は、複数の走査配線および複数の信号配線が互いに交差するように設けられていると共に、両配線の交差部近傍に設けられたスイッチング素子を介して両配線と接続された絵素電極が設けられ、さらに、該絵素電極に接続された走査配線に隣接する走査配線と該絵素電極とが絶縁膜を介して一部重畳されて、重畳部の走査配線部分を下部電極とし、該重畳部の絵素電極部分を上部電極とする補助容量部が構成されているアクティブマトリクス基板において、該上部電極と該下部電極との短絡欠陥が生じている場合に欠陥を修正する方法であって、短絡欠陥部に任意の光エネルギーを照射して該短絡欠陥部周辺の上部電極を除去し、そのことにより上記目的が達成される。

【００１４】前記光エネルギーとしてレーザー光を照射するのが好ましい。

【００１５】前記光エネルギーを照射するために発振波長が３６０ｎｍ以下の紫外線であるレーザーを用いるのが好ましい。

【００１６】前記光エネルギーとしてＹＡＧレーザーの第４高調波を照射するのが好ましい。

【００１７】本発明の液晶パネルの製造方法は、本発明のアクティブマトリクス基板の欠陥修正方法により欠陥を修正した後で、アクティブマトリクス基板と対向基板とを貼り合わせて両基板の間に液晶を注入する工程を含み、そのことにより上記目的が達成される。

【００１８】以下、本発明の作用について説明する。

【００１９】本発明にあっては、共通信号配線または走査配線（下部電極）と絶縁膜と絵素電極（上部電極）とで構成される補助容量部において、下部電極と上部電極との短絡欠陥が生じている場合に、光エネルギーを照射して短絡欠陥部周辺の上部電極を除去する。これにより、短絡欠陥部と絵素電極が隔離され、下部電極と上部電極との短絡が解消される。対向基板との貼り合わせ前のアクティブマトリクス基板の状態で欠陥修正を行うので、液晶パネル状態で欠陥修正を行った場合のようにガラス基板やカラーフィルタ形成部の屈折率や透過率の影響、液晶配向への影響等がなく、修正の信頼性が向上する。後工程に不良品が流れず、欠陥修正のために予め冗長構造を設けておく必要もないので、製造歩留りが向上する。

【００２０】この光エネルギーとしてレーザー光を用いれば、非接触で加工可能であるので素早く容易に修正することができる。

【００２１】発振波長が３６０ｎｍ以下の紫外線である短波長レーザー、例えばＹＡＧレーザーの第４高調波を用いれば、下層膜に影響を与えずに短絡欠陥周辺部の上部電極のみを精度良く除去することができる。

【００２２】

【発明の実施の形態】以下、本発明の実施形態について、図面を参照しながら説明する。

【００２３】（実施形態１）本実施形態ではＣｓ　ｏｎ　Ｃｏｍｍｏｎ構造のアクティブマトリクス液晶パネルについて説明する。

【００２４】図１は実施形態１の液晶パネルの平面図であり、図２はそのＩ－Ｉ’線部分の断面図である。

【００２５】この液晶パネルにおいて、アクティブマトリクス基板は、ガラス基板１１上に走査配線２および信号配線４が互いに交差して設けられ、両配線の交差部近傍にスイッチング素子６としてＴＦＴ（薄膜トランジスタ）が設けられている。両配線で区切られた矩形状の領域には絵素電極５がマトリクス状に配置され、スイッチング素子６を介して両配線と接続されている。

【００２６】さらに、隣接する走査配線２の間には走査配線２と平行な方向に共通信号配線３が設けられ、その上に絶縁膜７を介して絵素電極５が一部重畳している。この重畳部の共通信号配線３、絶縁膜７および絵素電極５から補助容量部１が構成されている。共通信号配線３は厚み３００ｎｍ～５００ｎｍ程度の金属薄膜、例えばＴａやＡｌ等からなり、絵素電極５は厚み１００ｎｍ～２００ｎｍ程度の透明導電膜、例えばＩＴＯ（Ｉｎｄｉｕｍ　Ｔｉｎ　Ｏｘｉｄｅ）等からなり、絶縁膜７は厚み３００ｎｍ～５００ｎｍ程度の絶縁膜（ゲート絶縁膜）、例えばSiN_xやSiO_x等からなる。

【００２７】このアクティブマトリクス基板は、ガラス基板１０上に対向電極９が設けられた対向基板と貼り合わせられ、両基板の間に液晶層８が挟持されている。

【００２８】この液晶パネルにおいて、図２に示すように、絶縁膜７にピンホール１２が発生して補助容量部の共通信号配線３と絵素電極５とが短絡している場合、対向電極９と共通信号配線３には同じ位相の電位が印加されているため、共通信号配線３に短絡した絵素電極５と対向電極９との間には電位が印加されない。よって、現在主流となっているノーマリホワイトモード液晶では常に輝点として表示され、表示品位を低下させる非常に目立った欠陥になってしまう。

【００２９】このような補助容量部１の短絡欠陥を従来のように液晶パネル状態で修正すると、ガラス基板やカラーフィルタ形成部の屈折率や透過率の影響、液晶配向への影響等のため修正が困難である。また、液晶層に修正により飛散した破片や異物等が残留して表示不良が生じるおそれもある。

【００３０】そこで、本実施形態では、図３に示すように、対向基板との貼り合わせ前のアクティブマトリクス基板状態で、短絡欠陥部１２に光エネルギーを照射して欠陥修正を行う。欠陥の検出は、画像処理や抵抗検査等の手法によって検出することができる。

【００３１】ここで、ＹＡＧレーザーの基本波等を照射すると、下層膜に影響を与えて共通信号配線３が切断されるおそれがあるため、本実施形態ではＹＡＧレーザーの第４高調波（２６６ｎｍ）等の短波長レーザーを用いる。

【００３２】これにより、図４に示すように、短絡欠陥部周辺の絵素電極部分１３を除去してピンホール１２を絵素電極５から隔離し、補助容量部の上部電極と下部電極の短絡を解消することができる。

【００３３】なお、補助容量部１の減少は絵素の表示状態に影響を与えるため、光エネルギーを照射して除去する面積は、設計マージン（例えば±５％以下等）を考慮して、例えば２μｍ□～５μｍ□以内等に調整する必要がある。

【００３４】絵素電極５が除去された部分では、対向電極との間に電位が印加されないので光漏れが発生するが、共通信号配線３が例えばＡｌやＴｉ、Ｔａ等の遮光性のある金属薄膜で形成されるので、問題は生じない。

【００３５】このように欠陥修正されたアクティブマトリクス基板と対向基板とを貼り合わせて両基板の隙間に液晶を注入することにより、本実施形態の液晶パネルが得られる。

【００３６】（実施形態２）本実施形態ではＣｓ　ｏｎ　Ｇａｔｅ構造のアクティブマトリクス液晶パネルについて説明する。

【００３７】図５は実施形態２の液晶パネルの平面図であり、図６はそのII－II’線部分の断面図である。

【００３８】この液晶パネルにおいて、アクティブマトリクス基板は、ガラス基板１１上に走査配線２および信号配線４が互いに交差して設けられ、両配線の交差部近傍にスイッチング素子６としてＴＦＴ（薄膜トランジスタ）が設けられている。両配線で区切られた矩形状の領域には絵素電極５がマトリクス状に配置され、スイッチング素子６を介して両配線と接続されている。

【００３９】さらに、絵素電極５は、その絵素電極５に接続された走査配線２と隣接する走査配線２上まで延在し、絶縁膜７を介してその走査配線２と一部重畳している。この重畳部の走査配線２、絶縁膜７および絵素電極５から補助容量部１が構成されている。走査配線２は厚み３００ｎｍ～５００ｎｍ程度の金属薄膜、例えばＴａやＡｌ等からなり、絵素電極５は厚み１００ｎｍ～２００ｎｍ程度の透明導電膜、例えばＩＴＯ等からなり、絶縁膜７は厚み３００ｎｍ～５００ｎｍ程度の絶縁膜（ゲート絶縁膜）、例えばSiN_xやSiO_x等からなる。

【００４０】このアクティブマトリクス基板は、ガラス基板１０上に対向電極９が設けられた対向基板と貼り合わせられ、両基板の間に液晶層８が挟持されている。

【００４１】この液晶パネルにおいて、図６に示すように、絶縁膜７にピンホール１２が発生して補助容量部の走査配線２と絵素電極５とが短絡している場合、走査配線２には対向電極９に対してマイナスの一定の電位がほぼ常に印加されているため、共通信号配線３に短絡した絵素電極５と対向電極９との間にはほぼ常に電位が印加される。よって、現在主流となっているノーマリホワイトモード液晶ではほぼ常に黒点として表示され、表示品位を低下させる欠陥になってしまう。

【００４２】このような補助容量部１の短絡欠陥を従来のように液晶パネル状態で修正すると、ガラス基板やカラーフィルタ形成部の屈折率や透過率の影響、液晶配向への影響等のため修正が困難である。また、液晶層に修正により飛散した破片や異物等が残留して表示不良が生じるおそれもある。

【００４３】そこで、本実施形態では、図７に示すように、対向基板との貼り合わせ前のアクティブマトリクス基板状態で、短絡欠陥部１２に光エネルギーを照射して欠陥修正を行う。欠陥の検出は、画像処理や抵抗検査等

の手法によって検出することができる。

【００４４】ここで、ＹＡＧレーザーの基本波等を照射すると、下層膜に影響を与えて走査配線２が切断されるおそれがあるため、本実施形態ではＹＡＧレーザーの第４高調波（２６６ｎｍ）等の短波長レーザーを用いる。

【００４５】これにより、図８に示すように、短絡欠陥部周辺の絵素電極部分１３を除去してピンホール１２を絵素電極５から隔離し、補助容量部の上部電極と下部電極の短絡を解消することができる。

【００４６】なお、補助容量部１の減少は絵素の表示状態に影響を与えるため、光エネルギーを照射して除去する面積は、設計マージン（例えば±５％以下等）を考慮して、例えば２μｍ□～５μｍ□以内等に調整する必要がある。

【００４７】絵素電極５が除去された部分では、対向電極との間に電位が印加されないので光漏れが発生するが、走査配線２が例えばＡｌやＴｉ、Ｔａ等の遮光性のある金属薄膜で形成されるので、問題は生じない。

【００４８】このように欠陥修正されたアクティブマトリクス基板と対向基板とを貼り合わせて両基板の隙間に液晶を注入することにより、本実施形態の液晶パネルが得られる。

【００４９】なお、上記実施形態１および実施形態２において、短絡欠陥部周辺の上部電極を除去して短絡欠陥部と絵素電極とを隔離する際に、（１）補助容量部１の減少が表示品位に影響を与えない程度であり、（２）光漏れが生じないようであれば、短絡部は残してその周囲部分だけを除去することも可能である。

【００５０】上記実施形態１及び実施形態２においては光エネルギーとしてＹＡＧレーザーの第４高調波を用いたが、下層膜に影響を与えないように条件を設定できるのであれば他のレーザーを用いてもよい。

【００５１】さらに、放射線やプラズマ等、レーザー光以外の光エネルギーを利用する方法も可能である。

【００５２】

【発明の効果】以上詳述したように、本発明による場合には、対向基板と貼り合わせて液晶を注入する前のアクティブマトリクス基板の状態で、従来では修正が困難であった補助容量部の上部電極と下部電極との短絡欠陥を解消して正常絵素に修正することができる。よって、修正不良を後工程に流さないようにして製造ロスを最低限に抑えることができ、製造歩留りを向上させて大幅なコストダウンを図ることができる。さらに、アクティブマトリクス基板の状態で欠陥修正を行うため、修正後の洗浄が可能であり、液晶層に異物が残留することが無いので修正の信頼性を向上することができる。

【図面の簡単な説明】

【図１】実施形態１の液晶パネルにおける絵素部の概略構成を示す平面図である。

【図２】実施形態１の液晶パネルにおける補助容量部の短絡欠陥を説明するための断面図である。

【図３】実施形態１のアクティブマトリクス基板の欠陥修正方法を説明するための断面図である。

【図４】実施形態１のアクティブマトリクス基板の欠陥修正方法を説明するための断面図である。

【図５】実施形態２の液晶パネルにおける絵素部の概略構成を示す平面図である。

【図６】実施形態２の液晶パネルにおける補助容量部の短絡欠陥を説明するための断面図である。

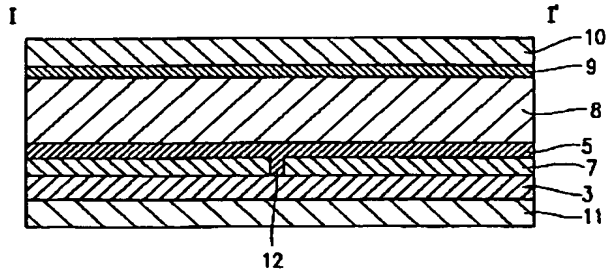
【図７】実施形態２のアクティブマトリクス基板の欠陥修正方法を説明するための断面図である。

【図８】実施形態２のアクティブマトリクス基板の欠陥修正方法を説明するための断面図である。

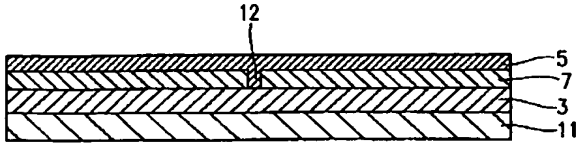
【符号の説明】

１　補助容量部
２　走査配線
３　共通信号配線
４　信号配線
５　絵素電極
６　スイッチング素子
７　絶縁膜（ゲート絶縁膜）
８　液晶層
９　対向電極
１０、１１　ガラス基板
１２　短絡欠陥部（ピンホール）
１３　レーザー照射により除去される絵素電極部分

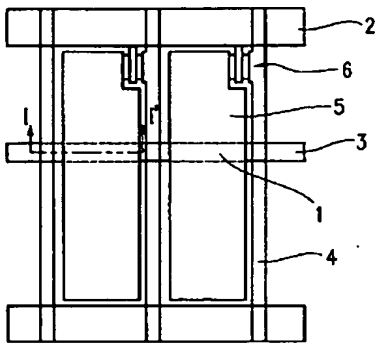
【図２】



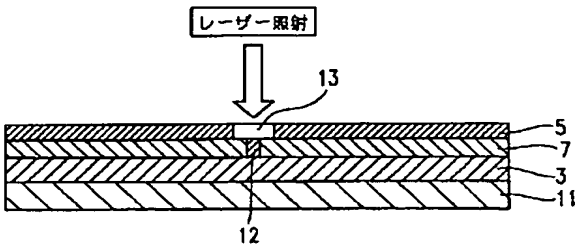
【図３】



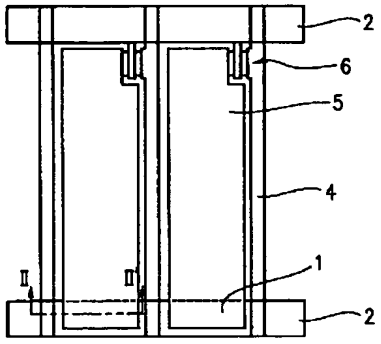
【図１】



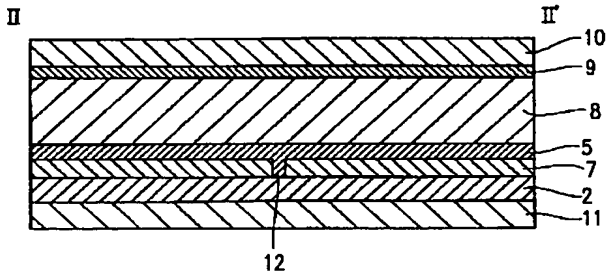
【図４】



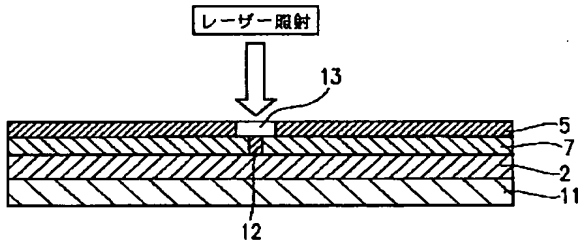
【図５】



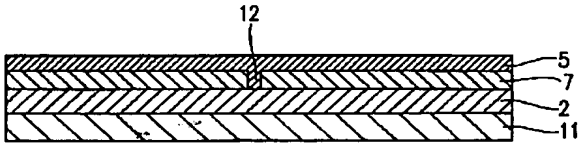
【図６】



【図８】



【図７】



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